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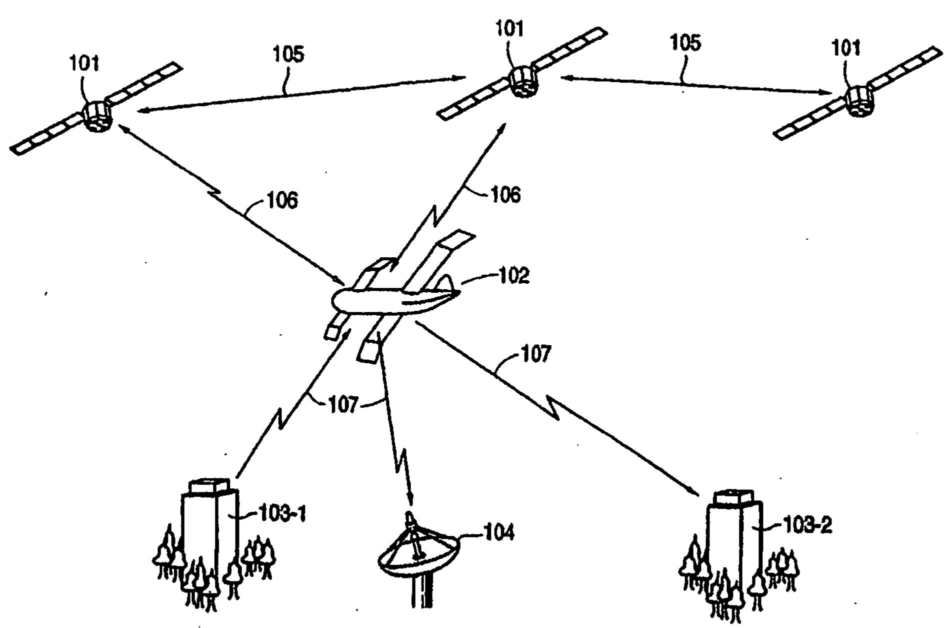

(57) Abstract

A communication system is provided in which an airborne atmospheric platform located in the Earth's atmosphere communicat with a network of satellites and with ground-based users. Because of its location in the atmosphere, the atmospheric platform tak advantages of previously unused high frequencies in communicating with the satellite network. The atmospheric platform communicat with ground-based users at a second, lower frequency.

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Wireless Communication Using Atmospheric Platform

FIELD OF THE INVENTION

The present invention is directed to a system and method for providing wireless communications through the use of atmospheric platforms stationed between a satellite network and Earth-bound users in order to provide connectivity between any two Earth-bound users anywhere on the planet. The present invention is particularly advantageous when employed in wireless broadband communication systems and wireless telephony communication systems.

BACKGROUND OF THE INVENTION

Over the last two decades, the worldwide appetite for timely information and effective communications services has grown tremendously. In recent years, new forms of communications services and technologies have become well-known (e.g., the Internet, faxes, modems, pagers, cell phones, etc.). In parallel with the increase in demand, new forms of technology have been developed to deliver voice, data, sound and video at ever increasing speed and decreasing costs.

The broadband communications market segment is the most recent to explode in demand. Simply stated, a broadband communications system is one which is able to provide any two users with bit rates sufficient for high-speed data and video. At the time of the present invention, broadband is defined as multi-megabit per second rates (e.g., speeds greater than 1 Megabit/second), which are far in excess of the multi-kilobit per second rates (for example, 28.8 kbps) currently supported by the telephone

networks. An analogy can be made to a pipe carrying water. A narrow pipe cannot convey a very large quantity of water in a short period of time. However, a very large pipe can move significantly more water in the same amount of time. A broadband communications system is similar to a very wide pipe in the sense that it can move the required volume (or bits) per unit time of information efficiently.

Currently, consumers and businesses are demanding the ability to connect with other users within their city and outside their city at high data rates (multi-megabit per second data rates, for example) in order to transmit and receive video, data and images.

Broadband communications is currently provided through either wired or wireless means. In a wired broadband system, communication between parties is facilitated by a physical connection, either through a cable plant, the telephone network (i.e. twisted copper pair), or optical fiber. While wired broadband solutions can be highly reliable, they are often too expensive to install and are typically regionally deployed. Therefore, wired broadband systems therefore cannot readily service a widespread community of subscribers.

Several types of wireless broadband solutions currently exist. One type of wireless broadband communications system involves terrestrial towers. According to this approach, multiple towers are installed around a region to be served, each tower serving a particular area of users. Wireless signals are transmitted from tower to tower, thereby facilitating broadband communications between users. An example of such a tower-based system currently in use is called Local Multipoint Delivery System

(LMDS). Tower-based wireless broadband solutions suffer from an important disadvantage. Namely, tower-based solutions only provide local coverage on the order of city blocks. Although many towers can be used to support large population of users, multiple towers are expensive to install, undesirable to view and require high capacity data communication lines to interconnect towers.

Another type of wireless broadband communications system uses satellites to communicate directly with Earth-bound users. Several types of satellites are used in these types of systems. Satellite-based broadband can be supported from Low-Earth orbit (LEO), medium-Earth orbit (MEO), highly elliptical orbit (HEO) or geostationary Earth orbit (GEO) satellites. Satellite-based wireless broadband systems offer the benefit of providing large area coverage (unlike terrestrial solutions), but suffer from four major limitations. Specifically, satellite-based wireless broadband systems (1) are power limited; (2) are stationed at great distance from the end user; (3) require transmission through the entire atmosphere in order to reach their target user; and, (4) are limited because of power and distance to the number of users they can serve per area, and cannot therefore serve high density population centers effectively.

Another segment of the communications market experiencing unprecedented growth is wireless telephony. Two modes currently are used for wireless telephony: wireless telephony for mobile users (known as cellular or PCS) and wireless telephony to homes or businesses (known as fixed wireless telephony or wireless local loop). In most of the developed world, mobile wireless telephony is growing at high rates. To support the increased demand, it is currently necessary to erect towers or place

antennas on the tops of buildings such that a typical city requires hundreds of towers or antenna sites in order to provide sufficient coverage and capacity. These towers are expensive to build and are limited in that they establish fixed service locations and require costly modification as populations shift and market demands change.

Fixed wireless telephony enjoys particular application in developing countries, where wired telephony infrastructure does not exist. The quickest and easiest way to provide the population of those countries with basic telephone service is via wireless telephony. Wireless telephony eliminates the need to bury cable or string wire. Currently, wireless telephony in areas without a wired telephony infrastructure is supported by establishing either a terrestrial tower-based system, which suffer from the same disadvantages noted above.

Therefore, a need exists for a more efficient and effective system and method of providing communications services to users.

SUMMARY OF THE INVENTION

According to the present invention, atmospheric platforms can be used for providing wireless communications services, for example, to 'super-metropolitan areas' which are 10's to 100's of miles in diameter. Atmospheric platforms have the advantage of ample power. Such platforms can operate above most commercial air traffic and weather, and above most of the atmosphere and its moisture. From this altitude they are also able to communicate with various satellites in various orbits. Also because of their altitude, the atmospheric platforms are able to use high

frequency links for "atmospheric platform to satellite" linkages because of the clear line of sight and lack of scattering and absorption. The connectivity between terrestrial users, atmospheric platforms and satellites are the basis for this invention and offer unique communications architectures for transacting data, images, sound, video and video-teleconferencing worldwide.

More specifically, according to the present invention, an atmospheric platform services a footprint of Earth-bound users and communicates with the users via wireless means. The atmospheric platform also communicates with a satellite constellation orbiting the Earth, again through wireless means. The atmospheric platform is located in the upper regions of the Earth's atmosphere, above the altitude bands of commercial civilian aviation and adverse weather. Because of the height of the atmospheric platform above the Earth, it is able to communicate with the satellite at high frequencies that are practically unusable for broadband communications between a satellite and a terrestrial user. Such high frequencies would typically be distorted and attenuated by rainfall and atmospheric gases. Having an atmospheric platform placed in the upper atmosphere allows the atmospheric platform to utilize high frequencies in communications with the satellite and then communicate with the Earth-based users with lower frequencies. Such a combination of satellites and atmospheric platforms allows for data to be transacted more efficiently between any two users on the planet than was possible with older prior art systems. The present invention is particularly useful in broadband data communications systems and wireless telephony systems, both mobile and fixed.

BRIEF DESCRIPTION OF THE FIGURES

Figure 1 is a diagram depicting a first embodiment of the present invention.

Figure 2 is a diagram depicting communication between users in different footprints according to the first embodiment of the present invention.

Figure 3 is a diagram illustrating the advantages obtained according to the first embodiment of the present invention.

Figure 4 is a diagram depicting a second embodiment of the present invention.

Figure 5 is a diagram depicting a third embodiment of the present invention.

Figure 6 is a diagram depicting particular advantages of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

According to the present invention, atmospheric platforms are used in conjunction with a satellite network in order to facilitate communications between ground-based users. Referring to Figure 1, a communication system is provided in which ground-based users 103 can be interconnected in a manner which allows them to communicate using very high data rates. The system of Figure 1 includes an atmospheric platform 102 which is located above the Earth in the upper region of the atmosphere. More specifically, the location of atmospheric platform 102 must be above the flight corridors of commercial and general aviation air traffic and above significant weather. It is preferred that the atmospheric platform 102 be located at least 52,000 feet above ground. Also shown in Figure 1 are satellites 101 which orbit the Earth and communicate with atmospheric platform 102. Atmospheric platform 102

is capable of communicating with a multitude of satellites 101 interconnected by intersatellite linkages 105. These intersatellite linkages 105 typically utilize wide swaths of spectrum at higher frequencies to interconnect such satellites.

The operation of the system depicted in Figure 1 will first be described for the situation in which users within the same "cone of commerce" or "footprint" communicate with each other. Users within the same "cone of commerce" or "footprint" are those users 103 which are served by the same atmospheric platform 102. Referring to the figure, if user 103-1 wishes to communicate with user 103-2, user 103-1 sends a wireless signal 107 to the atmospheric platform 102. The frequency of the signal 107 between the atmospheric platform and the user must be such that the signal has acceptable propagation characteristics in the atmosphere. The signal 107 may be attenuated too strongly by rain droplets and atmospheric gases. In a wireless broadband communication system, it is preferred that the frequency of the signals 107 be well under 60 GHz. In a wireless telephony system, it is preferred that the frequency of signals 107 be less than 10 GHz.

Next, the atmospheric platform communicates either directly with the other user, here user 103-2, or with a gateway 104. Gateway 104 is connected either to the public switched telephone network or to a fiber backbone which provides access, for example, to the Internet.

Users 103 can communicate with other users outside of their own footprint by one of two methods. As in the example, user 103-1 wishing to communicate with another user outside of his or her own footprint first sends a message to its local

atmospheric platform 102. Then, the atmospheric platform sends a wireless signal 107 to a gateway 104, again connected to either the public switched telephone network or to a fiber backbone connected to the Internet.

A second way for a user to communicate outside his or her own footprint is depicted in Figure 2. A user 206 communicates via signal 211 (having a frequency appropriate for terrestrial wireless applications as signal 107 described with respect to Figure 1) to an atmospheric platform 200. The atmospheric platform 200 in turn communicates via wireless signal 212 with a satellite 201. Significantly, signal 212 can utilize a higher frequency as compared to the frequency of signals between the atmospheric platform and a user (i.e., signals 211 in Figure 2 and signals 107 in Figure 1). Satellite 201 is one of several in a collection of satellites. At any given time, each satellite has an associated atmospheric platform which services a unique footprint containing users. In the present example, satellite 201 communicates via intersatellite linkage or wireless signal 202 through satellite 203 to satellite 204. Satellite 204 then communicates via wireless signal 212 with its associated atmospheric platform 205. Atmospheric platform 205 services the user 209 with whom user 206 wishes to communicate. Atmospheric platform 205 communicates via wireless signal 211 to user 209 in footprint 210, thus effecting communication between users in different footprints. In this way, communication traffic can be "backhauled" or moved between different points contained in different footprints.

Atmospheric platforms (for example, platform 102 in Figure 1; platforms 200, 205 in Figure 2; and platform 304 in Figure 3) in accordance with the present

invention can be any device which remains airborne above commercial and general aviation air traffic (approximately, 52,000 feet or higher) and which is capable of physically supporting a wireless telecommunications payload. The atmospheric platform must be able to supply the payload with sufficient power, environmental control and thermal conditioning over a designated location or a designated flight path. In other words, the atmospheric platform must be capable of station-keeping; it cannot be a free-floating device. Preferably, the atmospheric platform according to the present invention includes an antenna array, a power generation capability, on-board digital switching, receive and transmit radios, a power-distribution bus, and environmental control and conditioning. As previously described, the atmospheric platform must be positioned at an altitude above commercial and general aviation and adverse weather, for example, approximately 52,000 feet. However, it is possible that a Concorde aircraft or an unusual storm might occasionally be found at that altitude. Such occasional occurrences by aviation and/or adverse weather are not detrimental to the present invention as long as the atmospheric platform is at an altitude where such occurrences are rare. The acceptable height above the Earth for placement of the atmospheric platform is dependent on the season, latitude and geography being considered. For example, it is possible to effectively operate the atmospheric platform at a lower altitude over polar regions as opposed to tropical regions where the weather (the tropopause) reaches higher into the atmosphere. So, for example, the atmospheric platform could be a lighter than air craft, for example, a balloon, or the atmospheric platform could be an airplane. Preferably, the atmospheric platform is a high altitude

long operation (HALO) aircraft which travels above the Earth at the required altitude in an a circle having a radius less than 5 miles.

The atmospheric platform of the present invention includes onboard digital switching. Referring to Figure 2, the user 206 can communicate with atmospheric platform 200 via wireless signal 211. The atmospheric platform 200 carries on board a digital switch 213 which can decide where the bits of data are to be sent. For example, the information transmitted by user 206 via signal 211 to atmospheric platform 200 can either stay within the footprint 208 and be sent to user 207, or the information can be sent out of the network via signal 112 which communicates to satellite 201.

Employing an atmospheric platform between the satellite and the ground offers particular advantages according to the present invention. First, referring to Figure 3, the present invention allows the satellite 301 and the atmospheric platform 304 to communicate via signal 303 which has a very high frequency, typically at 60-90 GHz or much higher such as laser light. These very high frequency signals are strongly degraded by the atmosphere and therefore were not used with the prior art methods, for example, where a satellite communicated directly with the ground. Therefore, the present invention effectively utilizes previously unused higher frequencies in which considerable bandwidth is available. Once the satellite 301 interconnects with the atmospheric platform 304 at the high-frequency signals 303, atmospheric platform 304 can then use its own onboard power and antenna to essentially repeat or magnify signals at lower frequencies to communicate with ground based users.

Further, according to the present invention, the atmospheric platform, because of its abundant power, large antenna array and proximity to the ground is able to project a frequency reuse pattern through a multi-beam cellular pattern 306 and through dedicated spot beams within the given footprint 305. A frequency reuse pattern is a well known method of making efficient usage of spectrum. The number and size of the beams in a frequency reuse pattern is a function of the platform altitude, antenna array size, frequency used, available power, and the switching and network management capabilities. The amount of throughput between a terrestrial user and an atmospheric platform can be much higher per unit area than between a terrestrial user and a satellite.

Figure 4 illustrates a second, preferred embodiment of the present invention. As shown in Figure 4, an ideal configuration for the present invention includes a ring of satellites around the Earth's equator containing of 5 - 8 satellites 401 at an altitude band of 6000 - 12,000 km above the Earth. A minimum of five (5) satellites is required in the ring. Five satellites in the ring permits failure of one satellite while allowing the remaining satellites to communicate with each other. Ideally, the ring should contain six (6) satellites. With a ring of six satellites, every airborne atmospheric platform 404 is able to "see" at least two satellites at a given time. Eight (8) satellites in the ring allows for spare satellites.

The system of Figure 4, with satellites at approximately at 9,000 km above the Earth provides coverage for +/- 50 degrees of latitude, i.e., it is high enough to cover

most of the Earth's populated regions without incurring significant round-trip time delays due to the distance between the atmospheric platform and the satellite.

In a preferred embodiment, the addition of atmospheric platforms to the satellite ring around the equator, in effect, allows the footprint of the satellite system to be extended. Referring to Figure 6, satellite 601, positioned above the Earth at the equator, is able to communicate directly with locations covered by the footprint indicated by reference number 602. The size of this footprint is determined by the minimum "look angle" indicated by reference number 603. The typical minimum look angle is 5 to 10 degrees, which for a satellite at an altitude of approximately 9,000 kilometers would provide communications to +/- 50 degrees latitude. This minimum look angle, and therefore the footprint size, is limited in order to set the maximum amount of atmosphere through which the satellite signal must propagate. However, satellite 601 can readily communicate with atmospheric platform 604, which is outside of the footprint because signals traveling between the satellite and the atmospheric platform are not as strongly attenuated by the thin, dry atmosphere at altitudes above 52,000 feet. Atmospheric platform 604 can now communicate with users within its own footprint, which is significantly outside of the satellite's footprint 602. Therefore, the preferred embodiment as described effectively allows the footprint of satellite 601 to be increased through the use of atmospheric platforms outside of the range of the satellite's own footprint. While Figure 6 shows only one atmospheric platform 604, in typical practice, multiple atmospheric platforms would be used.

A third embodiment is found in Figure 5 which illustrates a highly elliptical system. Because most of the Earth's population is in the northern latitudes, highly elliptical satellite orbits with apogees above the northern region of Earth, provide excellent coverage over these regions. In other words, the loiter time for the satellites 502 shown in Figure 5 are greatest above the northern latitudes, thus allowing effective service to the Earth's most populated regions. Though Figure 5 shows only two elliptical orbits populated by multiple satellites, multiple elliptical satellite orbits populated by satellites could be employed to serve northern latitudes.

Several types of elliptical orbit can be used. For example, Molniya orbits which cause the satellite to travel very close to the Earth (less than 1,000 kilometers) when passing the southern-most region of the globe and very high above the Earth (approximately 40,000 kilometers) when passing over the northern-most regions. Other elliptical orbits, not as extreme as Molniya orbits, have so-called apogees on the order of 6,000 - 10,000 kilometers. These types of orbits can also be used with the present invention.

The present invention is not limited to the particular embodiments described above which have been chosen to illustrate the invention, with reference to the accompanying drawings.

WE CLAIM:

1. A communication system comprising:

a plurality of ground-based users;

at least one satellite traveling in an orbit around the Earth;

at least one airborne atmospheric platform located above said plurality of ground-based users and below the altitude of at least one satellite;

wherein said atmospheric platform communicates via wireless signals with said at least one satellite and said ground-based users.

2. The communication system of claim 1 wherein said atmospheric platform communicates with said at least one satellite utilizing a first frequency band and with said ground-based users through a second frequency band.

3. The communication system of claim 2 wherein said first frequency band is shifted higher than said second frequency band.

4. The communication system of claim 2 wherein said first frequency band is greater than 50 GHz and said second frequency band is less than 50 GHz.

5. The communication system of claim 2 wherein said first frequency band is greater than 60 GHz and said second frequency band is less than 60 GHz.

6. The communication system of claim 4 wherein said first frequency band is less than 100 GHz.

7. The communication system of claim 6 wherein said second frequency band is higher than 100 MHz.

8. The communication system of claim 1 wherein said communication system is a wireless broadband communication system.

9. The communication system of claim 1 wherein said communication system is a wireless telephony communication system.

10. The communication system of claim 4 wherein said first frequency band is at laser wave lengths.

11. The communication system of claim 1 wherein said atmospheric platform communicates with said at least one satellite at a frequency not practically allowing sufficient signal strength to reliably communicate in said communication system.

12. The communication system of claim 11 wherein said atmospheric platform communicates with said ground-based users at a frequency capable of

passing through the atmosphere with sufficient reliability for use in said communication system.

13. The communication system of claim 1 further comprising at least one gateway which is connected to terrestrial communications networks.

14. The communication system of claim 1 wherein said atmospheric platform is located in the Earth's atmosphere.

15. The communication system of claim 14 wherein said atmospheric platform is located at an altitude higher than most commercial and general aviation.

16. The communication system of claim 15 wherein said atmospheric platform is located at an altitude higher than substantially all adverse weather.

17. The communication system of claim 14 wherein said atmospheric platform is located at an altitude of at least 52,000 feet above MSL (mean sea level).

18. The communication system of claim 1 wherein said atmospheric platform is a lighter than air craft.

19. The communication system of claim 1 wherein said atmospheric platform is a high altitude long operation aircraft.

20. The communication system of claim 19 wherein said high altitude long operation aircraft is piloted.

21. The communication system of claim 19 wherein said high altitude long operation aircraft is unpiloted.

22. The communication system of claim 19 wherein said high altitude long operation aircraft travels in a circle having a radius less than approximately 5 miles.

23. The communication system of claim 1 wherein said atmospheric platform carries means for routing said wireless signals.

24. The communication system of claim 23 wherein said means for routing comprises a data communications switch.

25. A communication system for interconnecting a plurality of ground-based users, comprising:

a network of satellites orbiting the Earth at the equator;

a plurality of airborne atmospheric platforms located between said network of satellites and said ground-based users, said plurality of airborne atmospheric platforms communicating with said network of satellites and said ground-based users.

26. The communication system of claim 25 wherein said network of satellites includes five to eight satellites at an altitude of approximately 6,000 to 9,000 km above the Earth.

27. The communication system of claim 25 wherein said network of satellites includes six satellites.

28. A communication system for interconnecting a plurality of ground-based users, comprising:

a network of satellites orbiting in an elliptical orbit;

a plurality of airborne atmospheric platforms located between said network of satellites and said ground-based users, said plurality of airborne atmospheric platforms communicating with said network of satellites and said ground-based users.

29. A method of increasing the effective footprint of a satellite, comprising:

providing at least one satellite orbiting above the Earth;

providing at least one ground-based user at a location outside of the footprint of said satellite;

providing at least one airborne atmospheric platform capable of communicating with said at least one satellite and said at least one ground-based user;

transmitting a first signal from said at least one satellite to said at least one atmospheric platform;

transmitting a second signal related to said first signal from said at least one atmospheric platform to said at least one ground-based user.

30. A method for providing broadband communications to a plurality of ground-based users, comprising:

providing at least one satellite orbiting above the Earth;

providing at least one airborne atmospheric platform capable of communicating with said at least one satellite and said plurality of ground-based users;

transmitting a first signal from said at least one satellite to said at least one atmospheric platform;

transmitting a second signal related to said first signal from said at least one atmospheric platform to at least one of said plurality of ground-based users.

31. An atmospheric platform for use in a communication system, said atmospheric platform providing a communication link between ground-based users and orbiting satellites, wherein said atmospheric platform communicates with said

satellites at a first frequency band and said ground-based users at a second frequency band.

32. The atmospheric platform of claim 31 wherein said first frequency band is higher than said second frequency band.

33. The atmospheric platform of claim 32 wherein said first frequency band is less than 100 GHz.

34. The atmospheric platform of claim 33 wherein said second frequency band is above 100 MHz.

35. The atmospheric platform of claim 31 further comprising:

a power generation unit;

data communication switching means for routing signals through said communications link;

receive and transmit radios;

a power distribution system;

environmental control; and

thermal conditioning means.

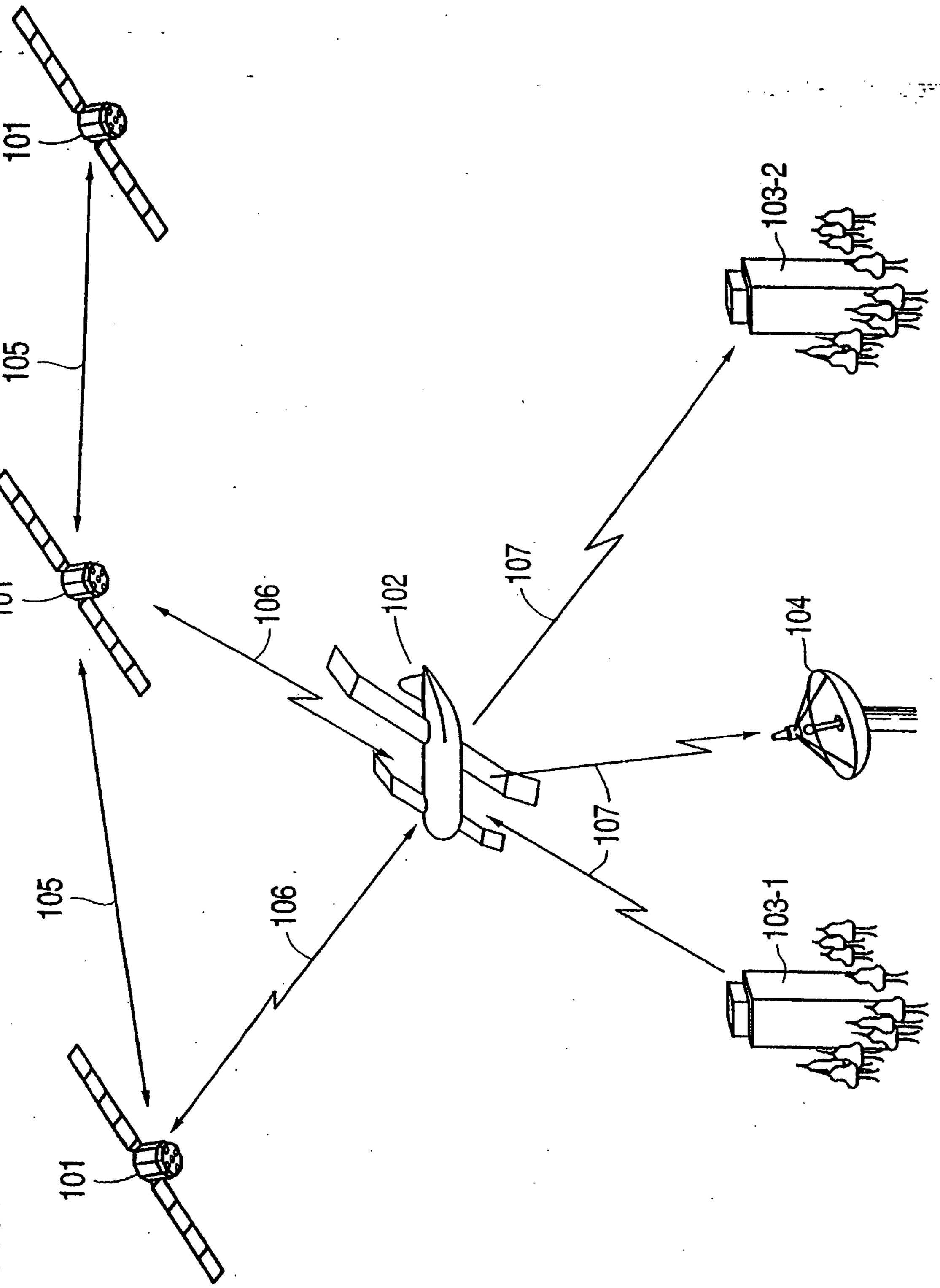
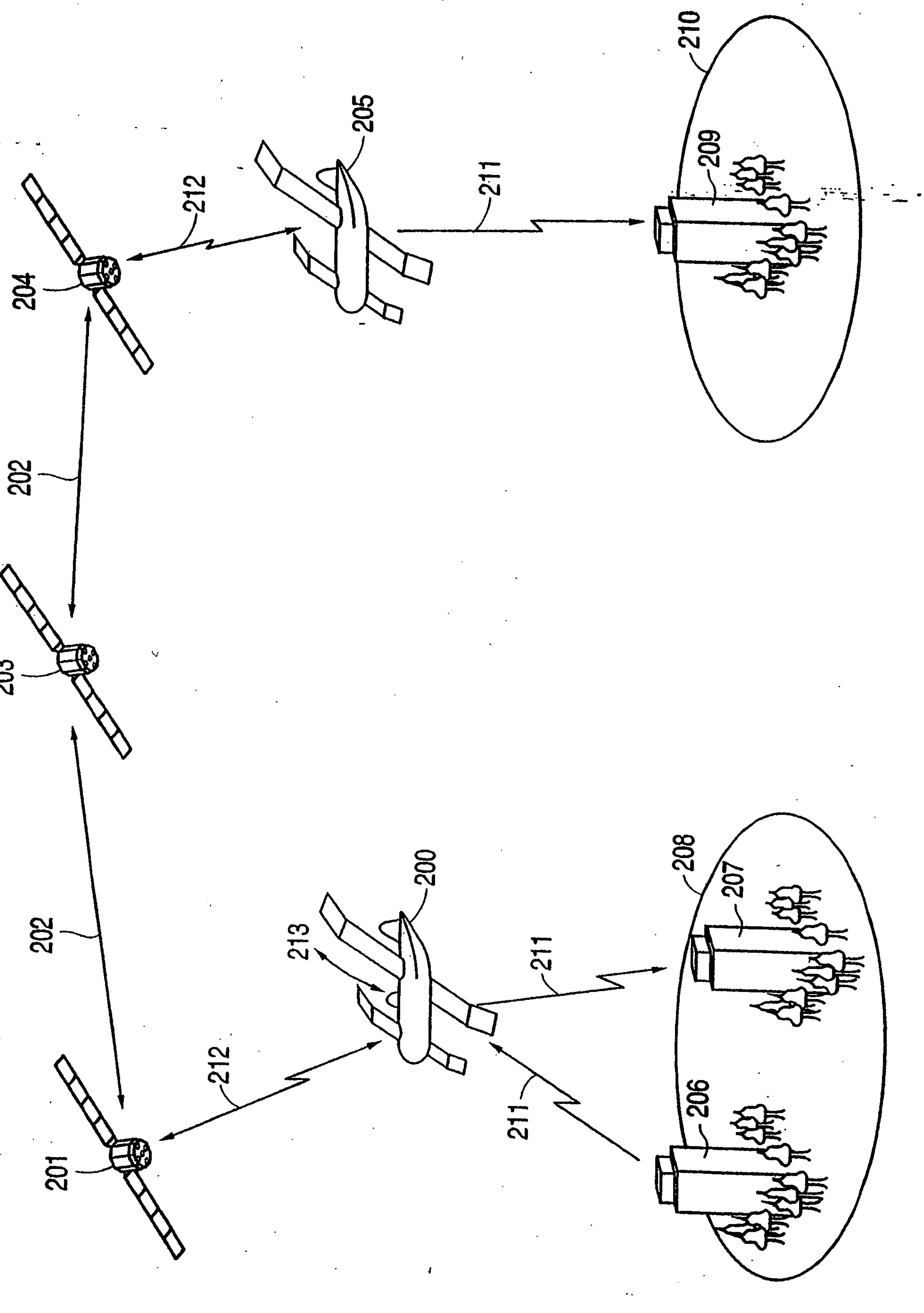


FIG. 1

FIG. 2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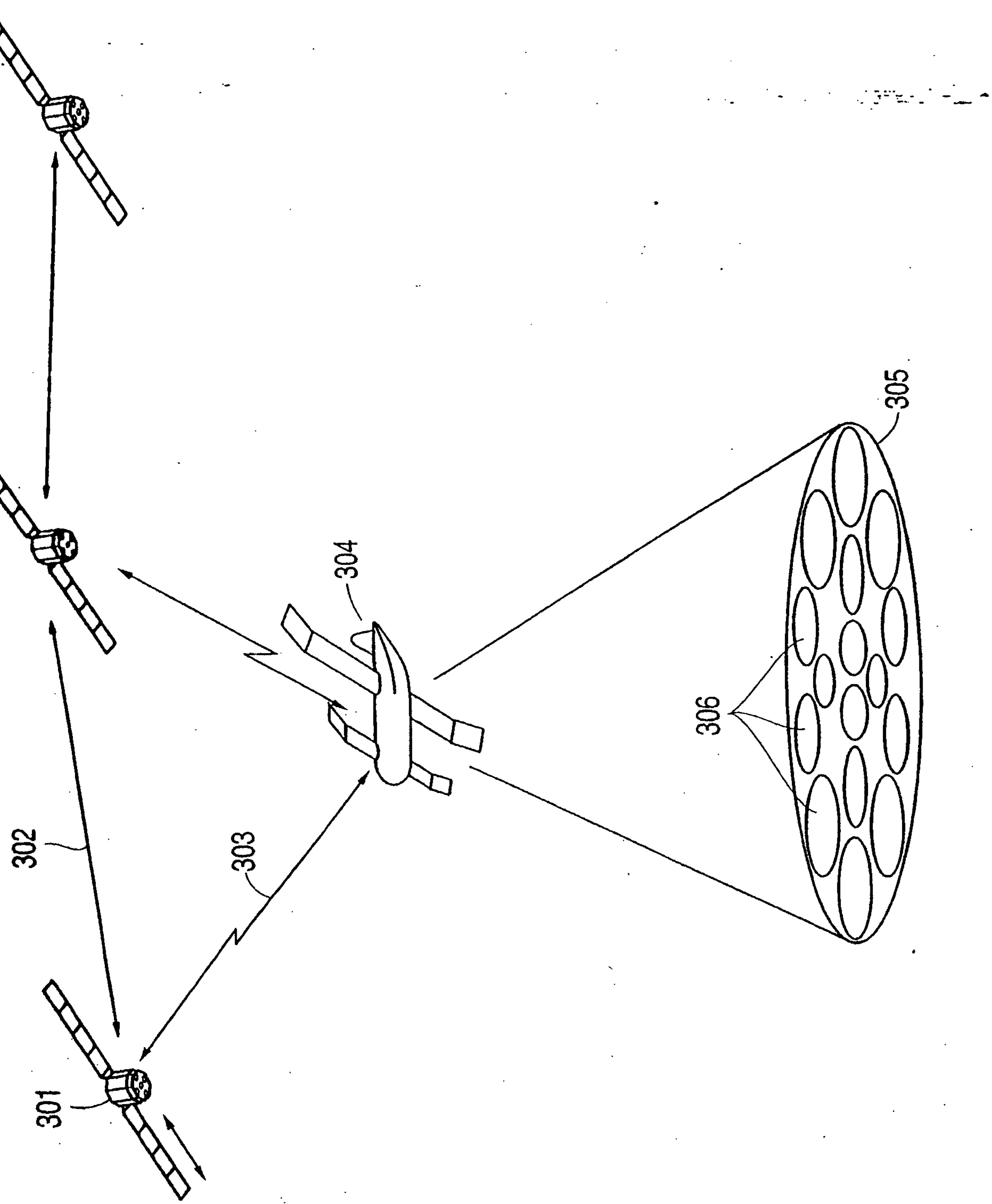


FIG. 3

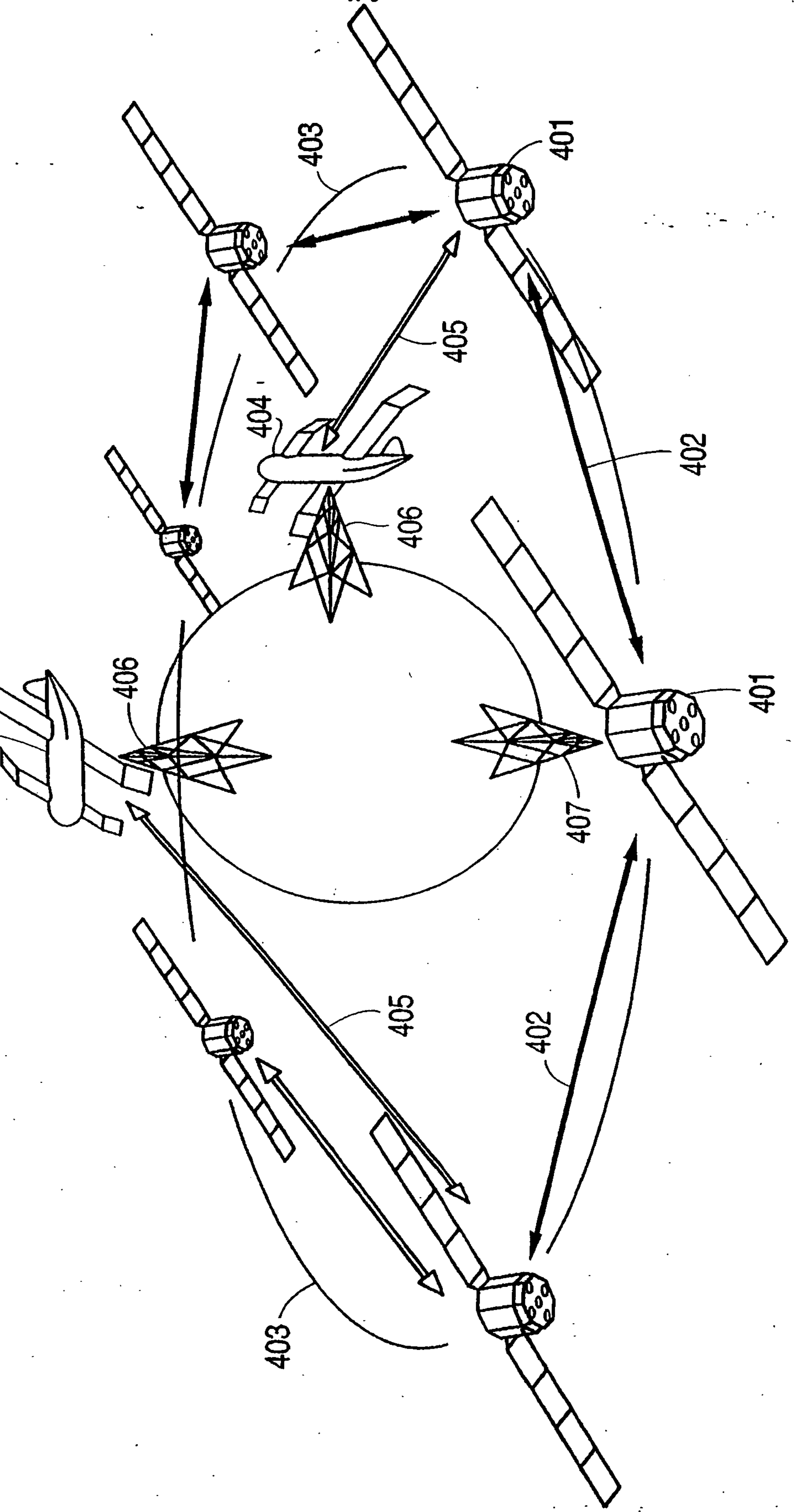
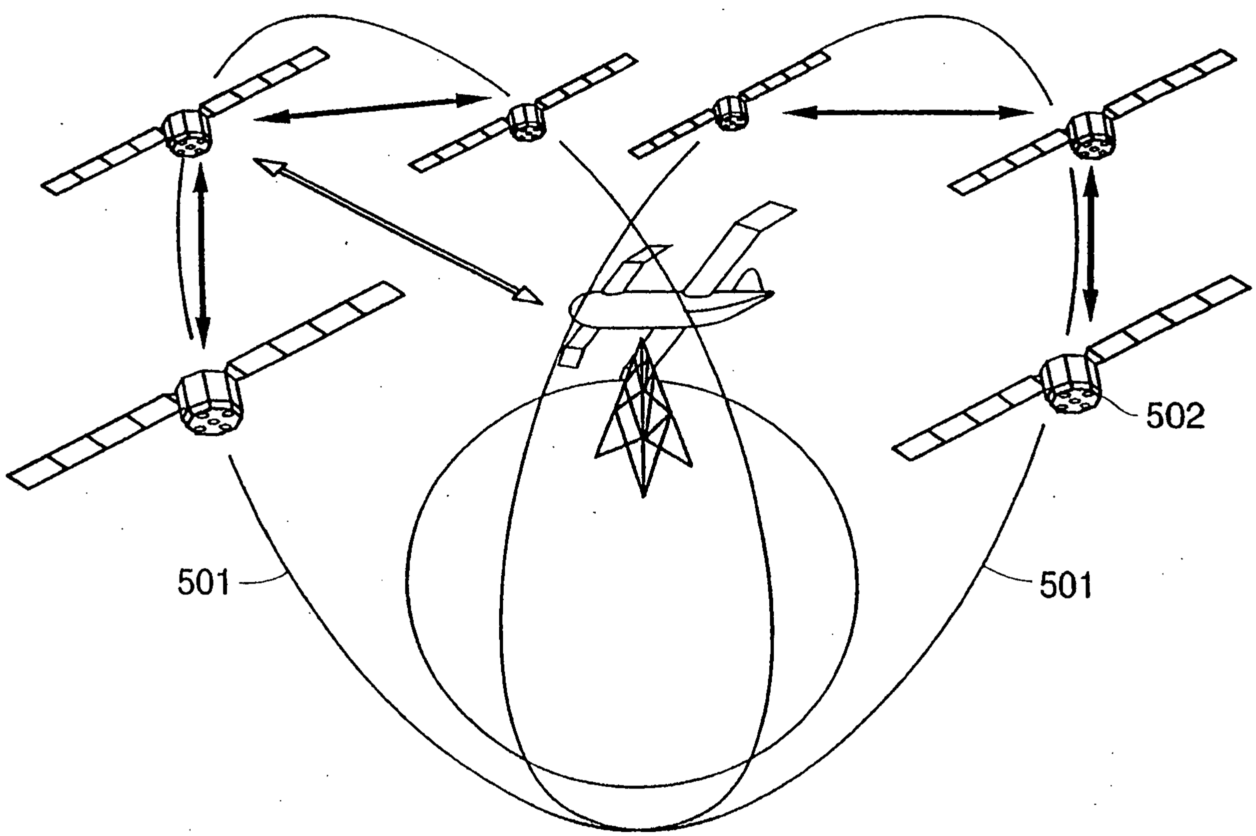


FIG. 4

FIG. 5



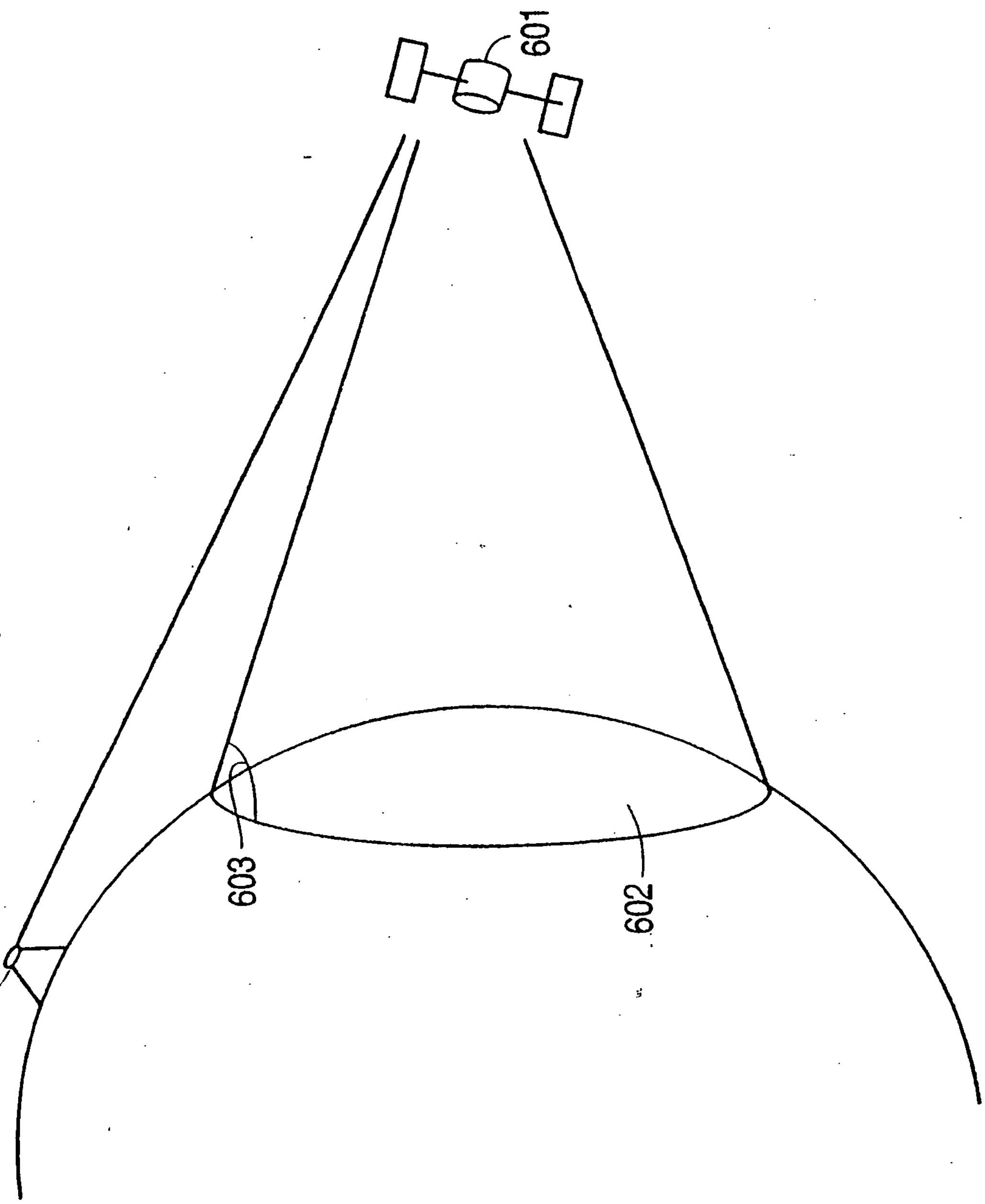


FIG. 6

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 98/18670

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H04B7/185

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,X	WO 98 35506 A (STANFORD TELECOMM INC) 13 August 1998 see abstract see page 2, line 15 - page 3, line 27 see page 5, line 14 - page 6, line 18 see page 7, line 3-14 see page 8, line 11-22 see page 12, line 1-25 see page 13, line 8 - page 14, line 10 see page 15, line 10 - page 16, line 22 see figures 2-4,6,10A-C see claims ---	1-4, 6-18,24, 25,30-34

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
9 February 1999	16/02/1999

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Dejonghe, O

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 98/18670

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
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X	DAVID A. BROWN: "Balloon technology offers high-altitude applications" AVIATION WEEK & SPACE TECHNOLOGY, 16 November 1992, pages 56-57, XP000770740 see the whole document see figures ---	1
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INTERNATIONAL SEARCH REPORT

Information on patent family members

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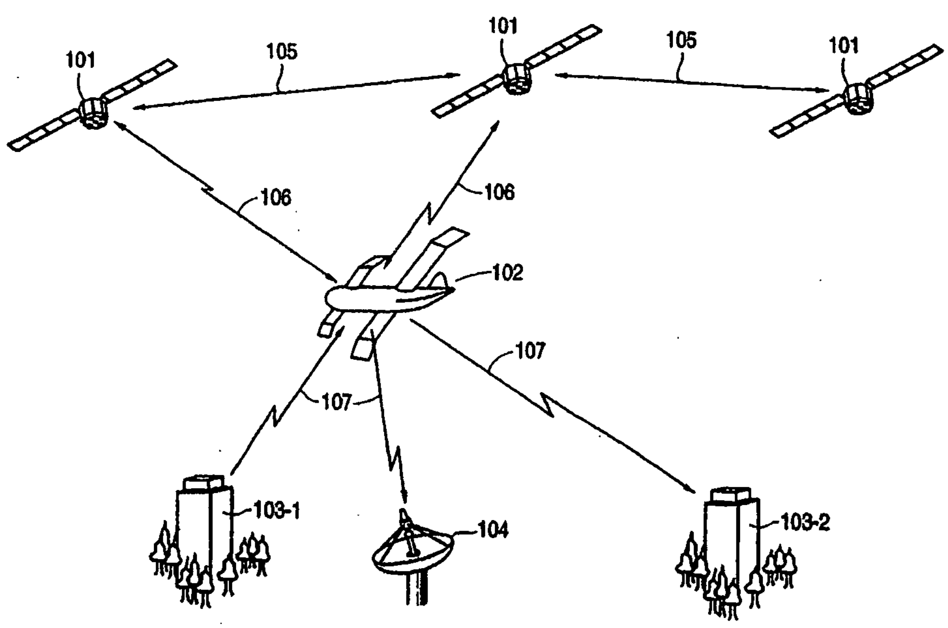
(54) Title: WIRELESS COMMUNICATION USING ATMOSPHERIC PLATFORM



(57) Abstract

A communication system is provided in which an airborne atmospheric platform located in the Earth's atmosphere communica with a network of satellites and with ground-based users. Because of its location in the atmosphere, the atmospheric platform ta advantages of previously unused high frequencies in communicating with the satellite network. The atmospheric platform communica with ground-based users at a second, lower frequency.

6. The communication system of claim 4, wherein said first frequency band is less than 100 GHz.

7. The communication system of claim 6, wherein said second frequency band is higher than 100 MHz.

8. The communication system of claim 1, wherein said communication system is a wireless broadband communication system with data throughput rate in excess of 1 Gigabit per second.

9. The communication system of claim 4, wherein said first frequency band is at laser wave lengths.

10. The communications system of Claim 1, wherein said manned aircraft communicates with said at least one satellite at a frequency not practically allowing sufficient strength of signal for a ground-based terminal of comparable antenna gain to communicate directly with said satellite, due to significant absorption of the signal by the atmospheric layer between the said ground-based terminal and said manned aircraft.

11. The communication system of claim 1, wherein said manned aircraft is a high altitude long operation piloted aircraft.

12. The communication system of claim 1, wherein said manned aircraft is a high altitude long operation piloted aircraft that maintains an assigned station by flying within a volume of airspace whose horizontal radius measured from a designated center of said assigned station is kept less than 5 nautical miles.

13. A communication system for interconnecting a plurality of ground-based users, comprising:

a network of satellites orbiting the Earth at the equator; and

a plurality of airborne atmospheric platforms located between said network of satellites and said ground-based users, said plurality of airborne atmospheric platforms communicating with said network of satellites and said ground-based users.

14. A communication system for interconnecting a plurality of ground-based users, comprising:

a network of satellites orbiting Earth at the equator; and

a plurality of heavier-than-air manned aircraft located at an altitude between said network of satellites and above said ground-based users, said plurality of manned aircraft communicating with said network of satellites and said ground-based users,

wherein said network of satellites includes five to eight satellites at an altitude of approximately 6,000 to 9,000 km above the Earth.

15. The communication system of Claim 14, wherein said network of satellites consists of six satellites.

16. A communication system for interconnecting a plurality of ground-based users, comprising:

a network of satellites orbiting in an elliptical orbit; and

a plurality of airborne atmospheric platforms located between said network of satellites and said ground-based users, said plurality of airborne atmospheric platforms communicating with said network of satellites and said ground-based users.

17. A method of increasing the effective footprint of a satellite, comprising:

providing at least one satellite orbiting above the Earth;

providing at least one ground-based user at a location outside of the footprint of said satellite;

providing at least one airborne atmospheric platform capable of communicating with said at least one satellite and said at least one ground-based user;

transmitting a first signal from said at least one satellite to said at least one atmospheric platform; and

transmitting a second signal related to said first signal from said at least one atmospheric platform to said at least one ground-based user.

18. A method for providing broadband communications to a plurality of ground-based users, comprising:

providing at least one satellite orbiting above the Earth;

providing at least one airborne atmospheric platform capable of communicating with said at least one satellite and said plurality of ground-based users;

transmitting a first signal from said at least one satellite to said at least one atmospheric platform; and

transmitting a second signal related to said first signal from said at least one atmospheric platform to at least one of said plurality of ground-based users.

19. An atmospheric platform for use in a communication system, said atmospheric platform providing a communication link between ground-based users and orbiting satellites, wherein said atmospheric platform communicates with said satellites at a first frequency band and said ground-based users at a second frequency band.

20. The atmospheric platform of claim 19, wherein said first frequency band is higher than said second frequency band.

21. The atmospheric platform of claim 20, wherein said first frequency band is less than 100 GHz.

22. The atmospheric platform of claim 21, wherein said second frequency band is above 100 MHz.